

PCT

(PCT Article 36 and Rule 70)

Form PCT/IPEA/409 (cover sheet) (April 2005)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/001509**Box No. I Basis of the report**

1. With regard to the language, this report is based on:
- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))
2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
- ☐ the international application as originally filed/furnished
- ☒ the description:
- | | | |
|--|--------------------------------------|--|
| <input checked="" type="checkbox"/> pages | <u>1 to 2, 11 to 15 and 17 to 39</u> | as originally filed/furnished |
| <input checked="" type="checkbox"/> pages* | <u>6, 7, 9, 10 and 16</u> | received by this Authority on <u>15 June 2005 (15.06.05)</u> |
| <input checked="" type="checkbox"/> pages* | <u>3 to 5 and 8</u> | received by this Authority on <u>14 November 2005 (14.11.05)</u> |
- ☒ the claims:
- | | |
|--|--|
| <input type="checkbox"/> pages | as originally filed/furnished |
| <input type="checkbox"/> pages* | as amended (together with any statement) under Article 19 |
| <input checked="" type="checkbox"/> pages* | <u>40 to 60</u> received by this Authority on <u>14 November 2005 (14.11.05)</u> |
| <input type="checkbox"/> pages* | received by this Authority on |
- ☐ the drawings:
- | | |
|---------------------------------|-------------------------------|
| <input type="checkbox"/> pages | as originally filed/furnished |
| <input type="checkbox"/> pages* | received by this Authority on |
| <input type="checkbox"/> pages* | received by this Authority on |
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.
3. ☒ The amendments have resulted in the cancellation of:
- | | |
|---|--|
| <input type="checkbox"/> the description, pages | |
| <input checked="" type="checkbox"/> the claims, Nos. | <u>6, 7, 20, 21, 46, 50, 55, 59, 61 to 63, 65, 68, 71, 75, 78, 82, 84, 85, 87, 89 to 91, 94, 97, 102, 107, 109, 112, 114, 117, 119, 122, 124, 127, 129 and 132</u> |
| <input type="checkbox"/> the drawings, sheets/figs | |
| <input type="checkbox"/> the sequence listing (<i>specify</i>): | |
| <input type="checkbox"/> any table(s) related to sequence listing (<i>specify</i>): | |
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- | | |
|---|--|
| <input type="checkbox"/> the description, pages | |
| <input type="checkbox"/> the claims, Nos. | |
| <input type="checkbox"/> the drawings, sheets/figs | |
| <input type="checkbox"/> the sequence listing (<i>specify</i>): | |
| <input type="checkbox"/> any table(s) related to sequence listing (<i>specify</i>): | |

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	<u>1 to 102</u>	YES
	Claims	<u>none</u>	NO
Inventive step (IS)	Claims	<u>1 to 102</u>	YES
	Claims	<u>none</u>	NO
Industrial applicability (IA)	Claims	<u>1 to 102</u>	YES
	Claims	<u>none</u>	NO

2. Citations and explanations (Rule 70.7)

Reference is made to the following documents:

- D1: WO 03/022816 A1 (Equistar Chemicals, LP) 20 March 2003 (20.03.2003)
D2: US 5902884 (Clariant GmbH) 11 May 1999 (11.05.1999)
D3: CA 2196046 (Sankyo Company) 08 February 1996 (08.02.1996)
D4: CA 1026348 (Hoffman-La Roche Limited) 14 February 1978 (14.02.1978)
D5: Limburg, W.W.; Yanus, J.F.; Williams, D.J.; Goedde, A.O.; Pearson, J.M., *Journal of Polymer Science, Polymer Chemistry Edition*, 1975, 13(5), 1133-9.
D6: Ambrose, J.F.; Nelson, R.F., *J. Electrochem. Soc.*, 1968, 115, 1159-1164.
D7: Registry Number 86-74-8 CAPLUS (9H-Carbazole)
D8: Registry Number 1484-12-4 CAPLUS (9-Methyl-Carbazole)
D9: Registry Number 86-28-2 CAPLUS (9-Ethyl-Carbazole)
D10: Registry Number 1484-08-8 CAPLUS (9-Butyl-Carbazole)
D11: Registry Number 1150-62-5 CAPLUS (9-Phenyl-Carbazole)
D12: Registry number 56166-62-2 CAPLUS (9-Ethyl-2-Carbazaldehyde)
D13: Registry number 3110-89-1 CAPLUS (9-Methyl-2,7-dicarbazaldehyde)
D14: CA 2360826 (Université Laval) 30 April 2002 (30.04.2002)
D15: Liu, B.; Yu, W.-L.; Pei, J.; Liu, S.-Y.; Lai, Y.-H.; Huang, W., *Macromolecules*, 2001, 34(23), 7932-7940.
D16: Goldoni, F.; Janssen, A.J.; Meijer, E.W., *J. Polym. Sci. Part A*, 1999, 37, 4629-4639.

Novelty

The subject matter of claims 1 to 102 comply with Article 33(2) of the PCT.

D1 to D13 disclose carbazole derivatives which are unsubstituted or substituted at position 2 and/or 7. The carbazole derivatives of claims 1 to 39 differ from the compounds disclosed in D1 to D13 in that the selected substituents are different.

D14 discloses conjugated polycarbazole derivatives and their use as electroactive and photoactive materials. The oligocarbazole and polycarbazole derivatives of claims 40 to 102 differ from D14 in that they comprise a vinylene unit in the polymer backbone.

(See Supplemental Box)

Box No. VIII **Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

A statement in an application, such as found on page 2 which incorporates by reference any other document, does not comply with Article 5 PCT.

The general statement in the description at page 37 implies that the extent of protection may be expanded in some vague and not precisely defined way, and when used to interpret the claims renders them also unclear, contrary to Article 6 PCT.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Section V:

Inventive Step

The subject matter of claims 1 to 102 comply with Article 33(3) of the PCT.

The closest prior art is considered to be D14 which discloses conjugated polycarbazole derivatives and their use as electroactive and photoactive materials. The problem to be solved by the present application is considered to be the provision of further conjugated polycarbazoles. The oligocarbazole and polycarbazole derivatives of claims 40 to 102 differ from D14 in that they comprise a vinylene unit in the polymer backbone.

D15 discloses the synthesis of bipyridyl-containing conjugated polymers wherein the monomers are linked by C-C single, vinylene or ethynylene bonds. D15 further teaches that the use of a C-C single bond linker provides for polymeric systems having improved sensitivity to metal ions and as such teaches away from the carbazole vinylene oligomers and polymers of claims 1 to 102.

D16 discloses the synthesis and optical properties of copolymers of thienylene and vinylene carrying alkylthio side chains. The properties of these polymers are reported as being dependent on the ratio of the thiophene and vinylene building blocks. However, D16 is silent with respect to polycarbazole-based derivatives comprising a vinylene unit in the polymer backbone as taught in the present application.

Therefore, the subject matter of claims 1 to 102 is considered to involve an inventive step.

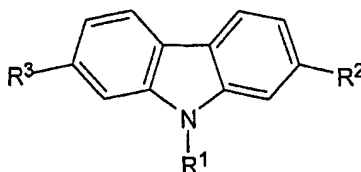
Industrial Applicability

The subject matter of claims 1 to 102 is considered to be industrially applicable and thus fulfilling the requirements of Article 33(4) PCT.

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More specifically, the present invention relates to a compound of Formula I:



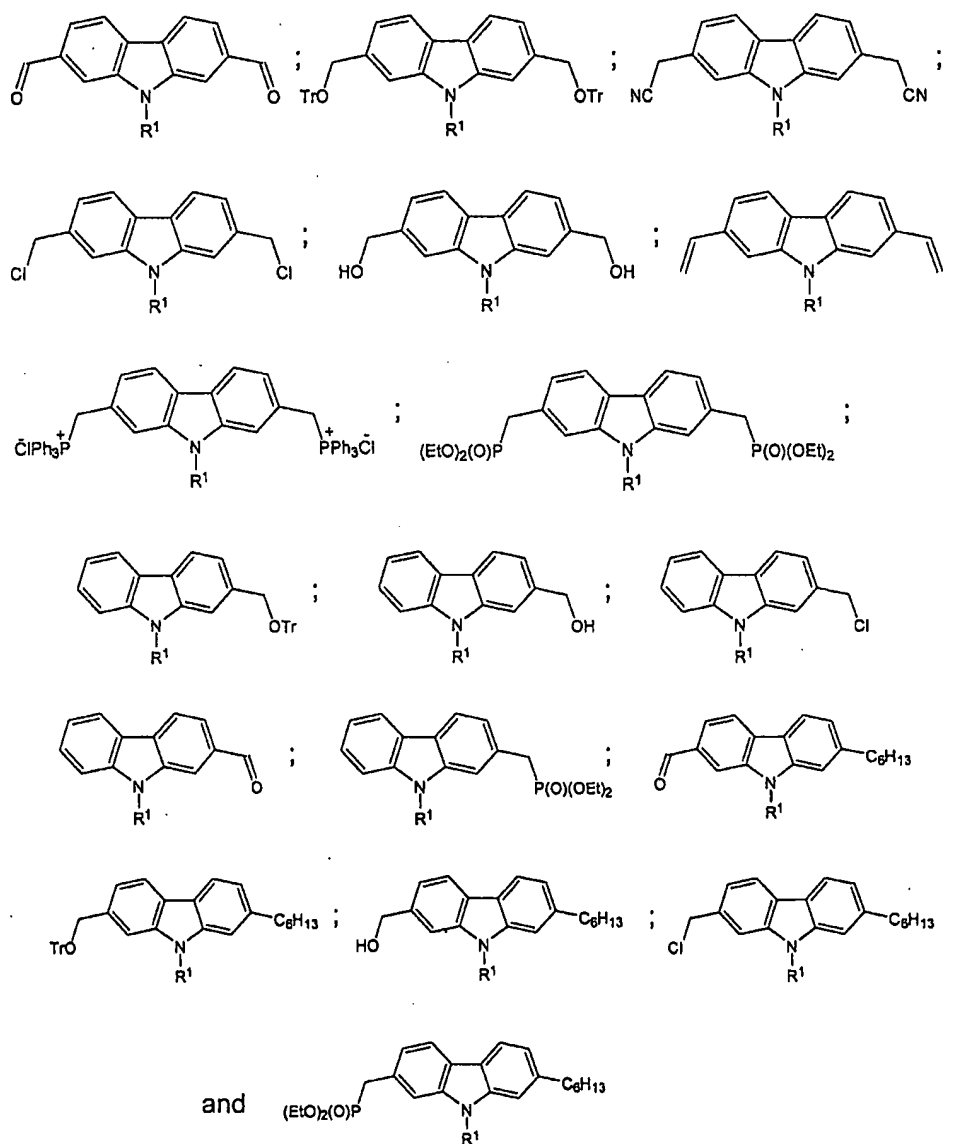
Formula I

[0010] wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl, and 4-octyloxyphenyl; R² and R³ are independently selected from the group consisting of H, methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, methyltriphenylphosphonium and vinyl,

[0011] with the proviso that: both R² and R³ are not H; when R¹ is methyl, both R² and R³ are not formyl; when R² is methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, or decyl, R³ is selected from the group consisting of formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, methyltriphenylphosphonium and vinyl; and when R¹ is ethyl, R² is selected from the group consisting of hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, and methyltriphenylphosphonium and R³ is selected from the group consisting of H, methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate,

methyltriphenylphosphonium and vinyl.

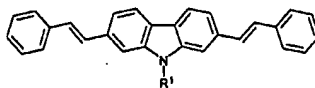
[0012] Yet more specifically, the present invention relates to 2 functionalized and 2,7-difunctionalized carbazoles selected from the group consisting of:



[0013] The present invention also relates to 2,7-carbazolenevinylene-based oligomers as well as to methods for preparing these oligomers.

[0014] Yet more specifically, the present invention relates to a 2,7-carbazolenevinylene-based oligomer comprising the reaction product of a first
5 compound of Formula I wherein at least one of R^2 or R^3 is selected from the group consisting of formyl, methyl diethylphosphonate, methyltriphenylphosphonium, cyanomethyl, and vinyl and wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octylphenyl, and at least a second
10 compound, said second compound being either a compound of Formula I wherein at least one of R^2 or R^3 is selected from the group consisting of formyl, methyl diethylphosphonate, methyltriphenylphosphonium, cyanomethyl, and vinyl and wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl,
15 cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octylphenyl; benzaldehyde; 5,5'-diformyl-2,2'-bithiophene, 4-bromo-1,1'-biphenyl; benzyl cyanide; or 1,4-bis(methylphosphonate)benzene.

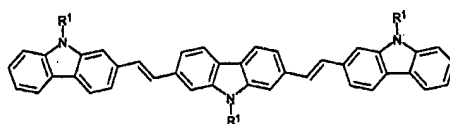
[0015] In a first particular embodiment, the present invention relates to a
20 2,7-carbazolenevinylene-based oligomer having the formula:



[0016] wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl,
25 nonyl, decyl, phenyl and 4-octyloxyphenyl.

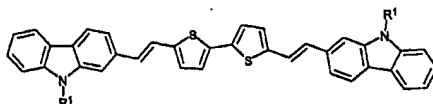
[0017] In a second particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based oligomer having the formula:

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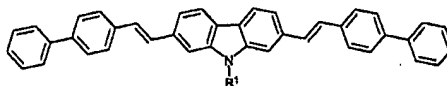
[0018] wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl,
5 nonyl, decyl, phenyl and 4-octyloxyphenyl.

[0019] In a third particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based oligomer having the formula:



[0020] wherein R¹ is selected from the group consisting of methyl, ethyl,
10 propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

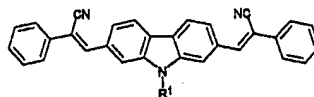
[0021] In a fourth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based oligomer having the formula:



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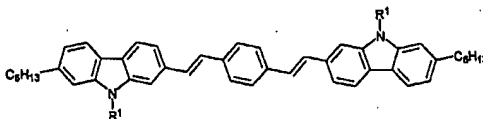
[0022] wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

20 [0023] In a fifth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based oligomer having the formula:



[0024] wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

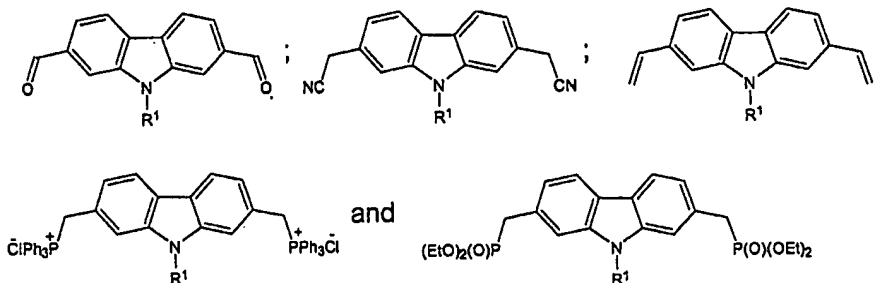
[0025] In a sixth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based oligomer having the formula:



[0026] wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

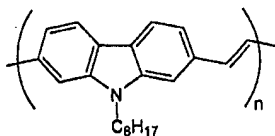
[0027] The present invention additionally relates to 2,7-carbazolenevinylene-based polymers as well as to methods of preparing these polymers.

[0028] Yet more specifically, the present invention relates to 2,7-carbazolenevinylene-based polymers comprising the reaction product of a compound selected from the group consisting of



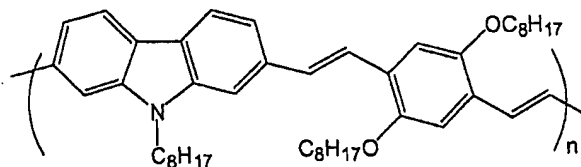
[0029] and optionally at least one compound selected from the group consisting of 2,5-dioctyloxy-1,4-diformylbenzene; 2,5-bis(diphenylamino)terephthalaldehyde; [4-(2-ethylhexyloxy)-phenyl]-bis-(4'-formylphenyl) amine; 6,6'-dibromo-2,2'-bis(2"-ethylhexyloxy)-1,1'-binaphthyl; and 3-hexyl-2,5-bis(methylphosphonate)thiophene.

[0030] In a first particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



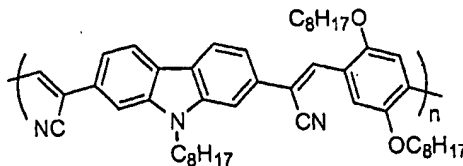
[0031] wherein "n" is an integer ranging from 5 to 100.

10 [0032] In a second particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



[0033] wherein "n" is an integer ranging from 5 to 100.

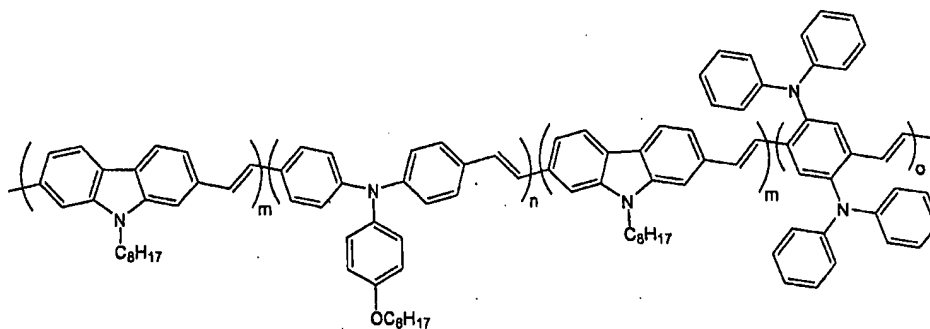
15 [0034] In a third particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



[0035] wherein "n" is an integer ranging from 5 to 100.

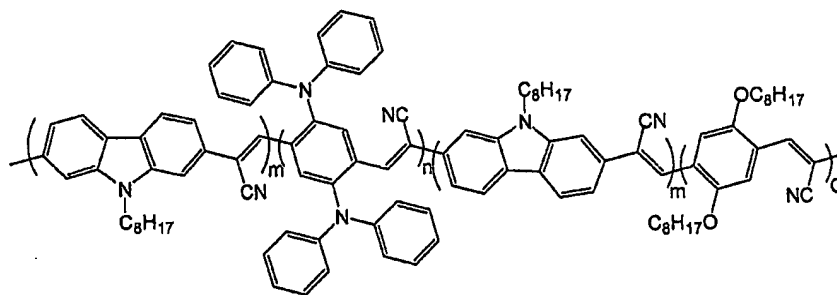
[0036] In a fourth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:

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[0037] wherein "n", "m" and "o" are integers ranging from 5 to 100.

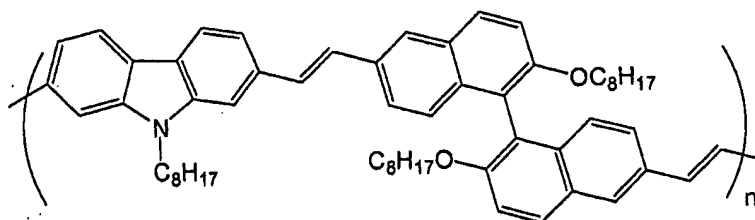
[0038] In a fifth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



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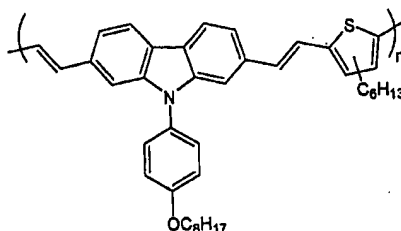
[0039] wherein "n", "m" and "o" are integers ranging from 5 to 100.

[0040] In a sixth particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



10 [0041] wherein "n" is an integer ranging from 5 to 100.

[0042] In a seventh particular embodiment, the present invention relates to a 2,7-carbazolenevinylene-based polymer having the formula:



[0043] wherein "n" is an integer ranging from 5 to 100.

[0044] The present invention also relates to 2,7-carbazolenevinylene-based oligomers and polymers for use in applications including but not limited to field-effect transistors, light-emitting devices such as light-emitting diodes, and solar cells.

[0045] Other objects, advantages and features of the present invention will become more apparent upon reading of the following non-restrictive description of preferred embodiments thereof, given by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] In the appended drawings:

[0047] Figure 1 illustrates the synthesis of novel 2,7-difunctionalized carbazoles;

15 [0048] Figure 2 illustrates the synthesis of 2-functionalized carbazoles;

[0049] Figure 3 illustrates the chemical structure of various oligomers;

[0050] Figure 4 illustrates the chemical structure of various polymers;

[0051] Figure 5 provides a schematic illustration of the polymerization yield obtained for various polymers as well as their molecular weight;

20 [0052] Figure 6 provides a schematic illustration of the optical properties of

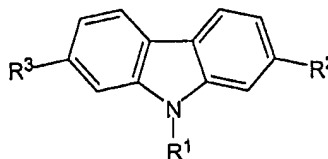
Büchner funnel. The resulting solid was washed thoroughly with water followed by methanol and dried under reduced pressure to provide 65.8 g of the title product as a white solid. M.P.: 250-251°C (Yield: 85%). ¹H NMR (300 MHz, CDCl₃, ppm): 7.87 (s, 1H); 7.58 (m, 14H); 7.38 (m, 22H); 4.36 (s, 2H); 4.30 (s, 2H). ¹³C NMR (75
5 MHz, CDCl₃, ppm): 149.32; 144.11; 143.73; 140.08; 139.37; 136.06; 134.82; 131.87; 130.53; 128.80; 128.71; 128.10; 127.97; 127.90; 127.37; 127.21; 127.16; 122.36; 87.58; 87.15; 65.40; 64.67.

[0068] **2,7-bis(trityloxymethyl)carbazole (7):** In a 500 mL flask, compound 6 (40.0 g, 54.2 mmol) and triethylphosphite (250 mL) were mixed and
10 refluxed under argon for 12 h. The mixture was cooled at 0°C and the precipitate was filtered through a Büchner funnel. The solid was washed thoroughly with methanol and dried under reduced pressure to provide 23.0 g of the title product as a white solid. M.P.: 240°C (dec.) (Yield: 60 %). ¹H NMR (400 MHz, THF-*d*₈, ppm): 10.24 (s, 1H); 7.94 (d, 2H, *J* = 8.0 Hz); 7.53 (m, 14H); 7.28 (m, 12H); 7.20
15 (m, 6H); 7.08 (dd, 2H, *J* = 8.0 and 1.4 Hz); 4.30 (s, 4H). The ¹³C NMR experiment could not be performed on this compound due to its very low solubility in common deuterated solvents.

[0069] ***N*-(2-ethylhexyl)-2,7-bis(trityloxymethyl)carbazole (8)⁹:** A 250 mL flask was charged with compound 7 (20.0 g, 28.4 mmol), sodium hydroxide (2.28
20 g, 56.8 mmol), tetrabutylammonium hydrogensulfate (0.48 g, 1.42 mmol), 2-ethylhexylbromide (11.0 g, 57.0 mmol, Aldrich Co.) and anhydrous acetone (140 mL). The resulting mixture was refluxed under argon for 24 h and then cooled at room temperature. Water (300 mL) was then added under vigorous stirring and the white precipitate formed was collected by filtration. The solid was dissolved in
25 a small amount of acetone and poured into methanol at 0°C. The precipitate was filtered and rinsed thoroughly with methanol to provide 21.6 g of the title product as a white solid. M.P.: 180-182°C (Yield: 93 %). ¹H NMR (300 MHz, CDCl₃, ppm): 8.15 (d, 2H, *J* = 8.0 Hz); 7.74 (d, 12H, *J* = 7.6 Hz); 7.68 (s, 2H); 7.46 (m, 12H);

WHAT IS CLAIMED IS:

1. A compound of Formula I:



Formula I

wherein:

R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl, and 4-octyloxyphenyl;

R² and R³ are independently selected from the group consisting of H, methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, methyltriphenylphosphonium and vinyl,

with the proviso that:

both R² and R³ are not H;

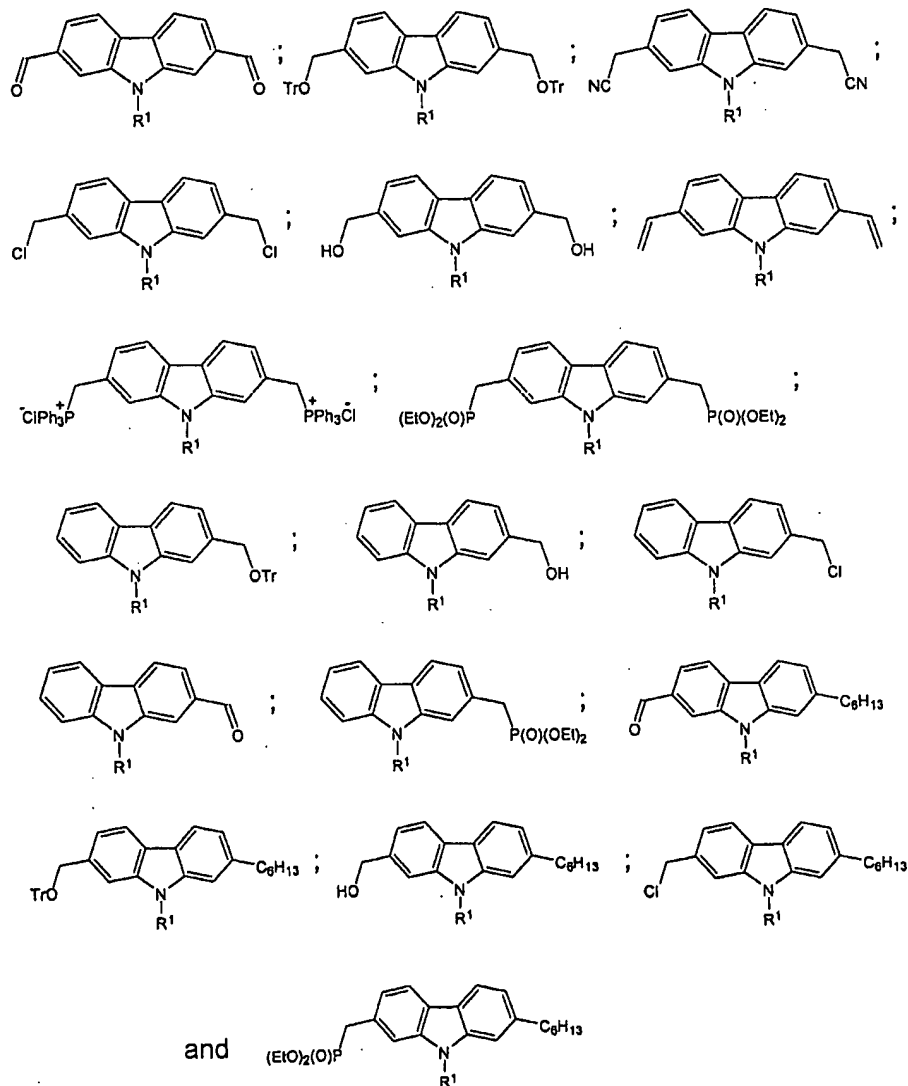
when R¹ is methyl, both R² and R³ are not formyl;

when R² is methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, or decyl, R³ is selected from the group consisting of formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, methyltriphenylphosphonium and vinyl; and

when R¹ is ethyl, R² is selected from the group consisting of hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, and methyltriphenylphosphonium and R³ is selected from the group consisting of H,

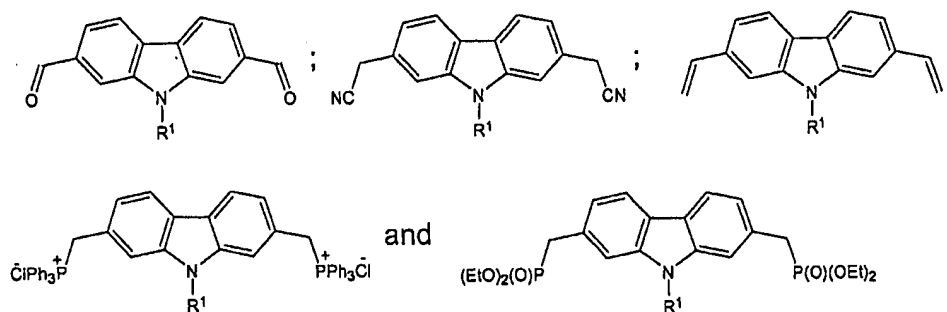
methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, formyl, hydroxymethyl, trityloxymethyl, cyanomethyl, chloromethyl, methyl diethylphosphonate, methyltriphenylphosphonium and vinyl.

2 A compound as defined in claim 1, selected from the group consisting of:



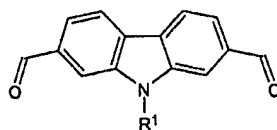
wherein R¹ is as defined in claim 1.

3. A compound as defined in claim 1, selected from the group consisting of:



wherein R^1 is as defined in claim 1.

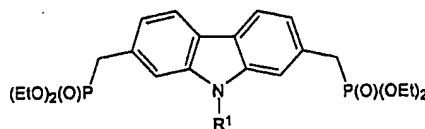
4. A compound as defined in claims 2 or 3 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, sec-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

5. A compound as defined in claim 4, wherein R^1 is hexyl, 2-ethylhexyl or 4-octyloxyphenyl.

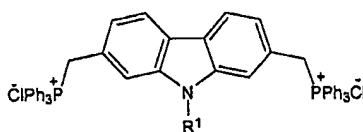
6. A compound as defined in claims 2 or 3 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

7. A compound as defined in claim 6, wherein R¹ is hexyl or 2-ethylhexyl.

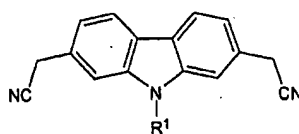
8. A compound as defined in claims 2 or 3 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

9. A compound as defined in claim 8, wherein R¹ is 2-ethylhexyl.

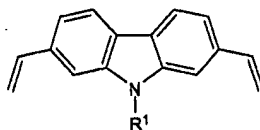
10. A compound as defined in claims 2 or 3 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

11. A compound as defined in claim 10, wherein R¹ is 2-ethylhexyl.

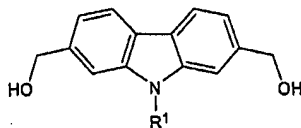
12. A compound as defined in claims 2 or 3 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

13. A compound as defined in claim 12, wherein R¹ is 2-ethylhexyl.

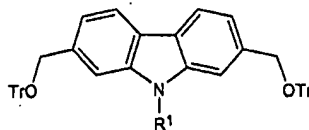
14. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

15. A compound as defined in claim 14, wherein R¹ is hexyl or 2-ethylhexyl.

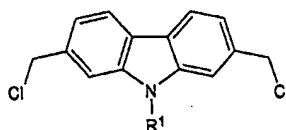
16. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

17. A compound as defined in claim 16, wherein R¹ is hexyl, 2-ethylhexyl or 4-octyloxyphenyl.

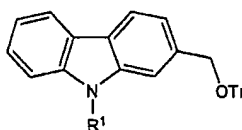
18. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

19. A compound as defined in claim 18, wherein R¹ is hexyl.

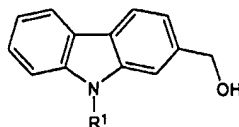
20. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

21. A compound as defined in claim 20, wherein R¹ is hexyl.

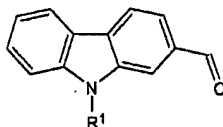
22. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

23. A compound as defined in claim 22, wherein R¹ is hexyl.

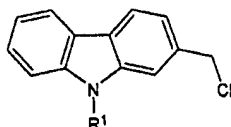
24. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

25. A compound as defined in claim 24, wherein R¹ is hexyl.

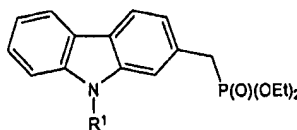
26. A compound as defined in claim 2 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

27. A compound as defined in claim 26, wherein R¹ is hexyl.

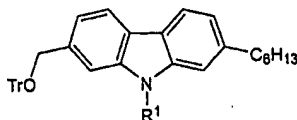
28. A compound as defined in claim 2 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

29. A compound as defined in claim 28, wherein R^1 is hexyl.

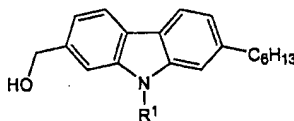
30. A compound as defined in claim 2 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

31. A compound as defined in claim 30, wherein R^1 is methyl.

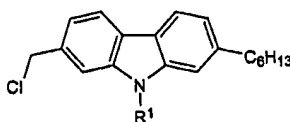
32. A compound as defined in claim 2 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

33. A compound as defined in claim 32, wherein R^1 is methyl.

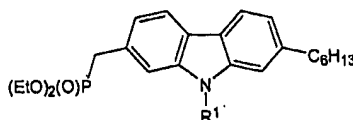
34. A compound as defined in claim 2 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

35. A compound as defined in claim 34, wherein R^1 is methyl.

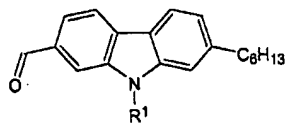
36. A compound as defined in claim 2 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

37. A compound as defined in claim 36, wherein R^1 is methyl.

38. A compound as defined in claim 2 having the formula:



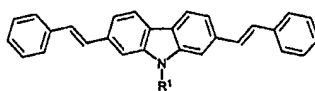
wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, and decyl.

39. A compound as defined in claim 38, wherein R^1 is methyl.

40. An oligomer comprising the reaction product of a first compound of Formula I as defined in claim 1, wherein at least one of R^2 or R^3 is selected from the group consisting of formyl, methyl diethylphosphonate, methyltriphenylphosphonium, cyanomethyl, and vinyl and wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl,

tert-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octylphenyl, and at least a second compound, said second compound being either a compound of Formula I as defined in claim 1, wherein at least one of R² or R³ is selected from the group consisting of formyl, methyl diethylphosphonate, methyltriphenylphosphonium, cyanomethyl, and vinyl and wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octylphenyl; benzaldehyde; 5,5'-diformyl-2,2'-bithiophene, 4-bromo-1,1'-biphenyl; benzyl cyanide; or 1,4-bis(methylphosphonate)benzene.

41. An oligomer as defined in claim 40 having the formula:

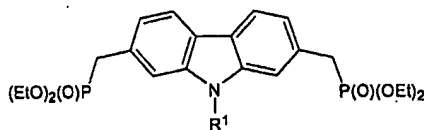


wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

42. An oligomer as defined in claim 41, wherein R¹ is hexyl or 2-ethylhexyl.

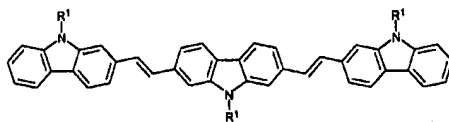
43. An oligomer as defined in claim 42, wherein R¹ is hexyl.

44. An oligomer as defined in claim 41 wherein the first compound of Formula I is of the formula:



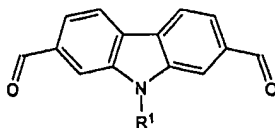
wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

45. An oligomer as defined in claim 44, wherein R^1 is hexyl or 2-ethylhexyl.
46. An oligomer as defined in claim 45, wherein R^1 is hexyl.
47. An oligomer as defined in any one of claims 41 to 46, wherein the second compound is benzaldehyde.
48. An oligomer as defined in claim 40 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

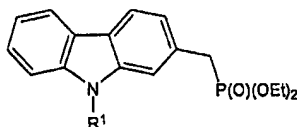
49. An oligomer as defined in claim 48, wherein R^1 is hexyl or 2-ethylhexyl.
50. An oligomer as defined in claim 49, wherein R^1 is hexyl.
51. An oligomer as defined in claim 48 wherein the first compound of Formula I is of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

52. An oligomer as defined in claim 51, wherein R^1 is hexyl, 2-ethylhexyl or 4-octyloxyphenyl.

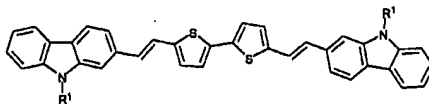
53. An oligomer as defined in claim 48 wherein the second compound of Formula I is of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

54. An oligomer as defined in claim 53, wherein R^1 is hexyl.

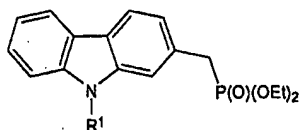
55. An oligomer as defined in claim 40 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

56. An oligomer as defined in claim 55, wherein R^1 is hexyl.

57. An oligomer as defined in claim 55 wherein the first compound of Formula I is of the formula:

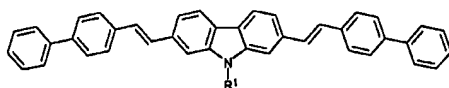


wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

58. An oligomer as defined in claim 57, wherein R¹ is hexyl.

59. An oligomer as defined in any one of claims 55 to 58, wherein the second compound is 5,5'-diformyl-2-2'bithiophene.

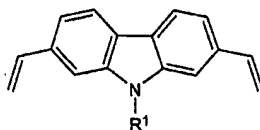
60. An oligomer as defined in claim 40 having the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

61. An oligomer as defined in claim 60, wherein R¹ is 2-ethylhexyl.

62. An oligomer as defined in claim 60 wherein the first compound of Formula I is of the formula:

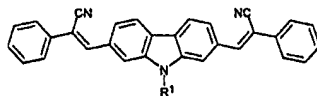


wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

63. An oligomer as defined in claim 62, wherein R^1 is 2-ethylhexyl.

64. An oligomer as defined in any one of claims 60 to 63, wherein the second compound is 4-bromo-1,1'-biphenyl.

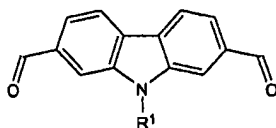
65. An oligomer as defined in claim 40 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

66. An oligomer as defined in claim 65, wherein R^1 is hexyl, 2-ethylhexyl or 4-octyloxyphenyl.

67. An oligomer as defined in claim 65 wherein the first compound of Formula I is of the formula:

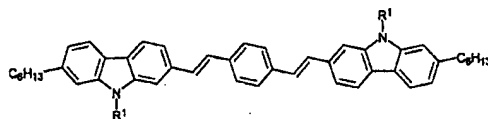


wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

68. An oligomer as defined in claim 67, wherein R^1 is hexyl, 2-ethylhexyl or 4-octyloxyphenyl.

69. An oligomer as defined in any one of claims 65 to 68, wherein the second compound is benzyl cyanide.

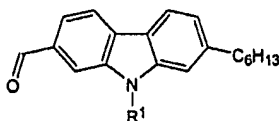
70. An oligomer as defined in claim 40 having the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

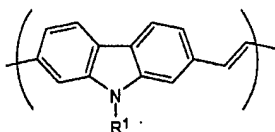
71. An oligomer as defined in claim 70, wherein R^1 is methyl.

72. An oligomer as defined in claim 70, wherein the first compound of Formula I is of the formula:



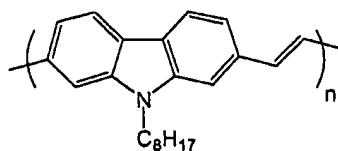
wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

76. A polymer as defined in claim 75, comprising monomeric groups of the formula:



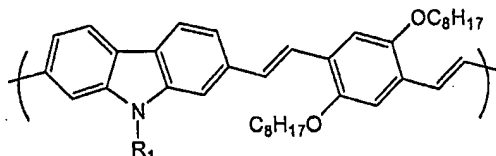
wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

79. A polymer as defined in claim 78 having the formula:



wherein "n" is an integer ranging from 5 to 100.

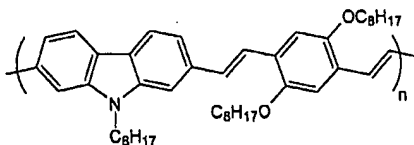
80. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

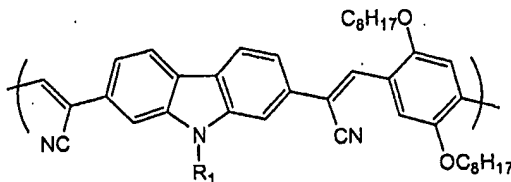
81. A polymer as defined in claim 80, wherein R^1 is hexyl or 2-ethylhexyl.

82. A polymer as defined in claim 81 having the formula:



wherein "n" is an integer ranging from 5 to 100.

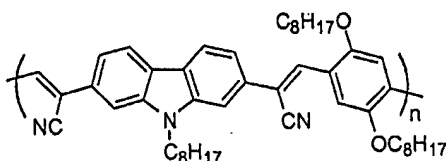
83. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

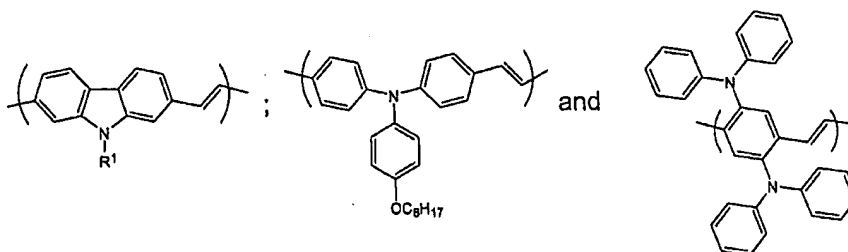
84. A polymer as defined in claim 83, wherein R¹ is hexyl or 2-ethylhexyl.

85. A polymer as defined in claim 84 having the formula:



wherein "n" is an integer ranging from 5 to 100.

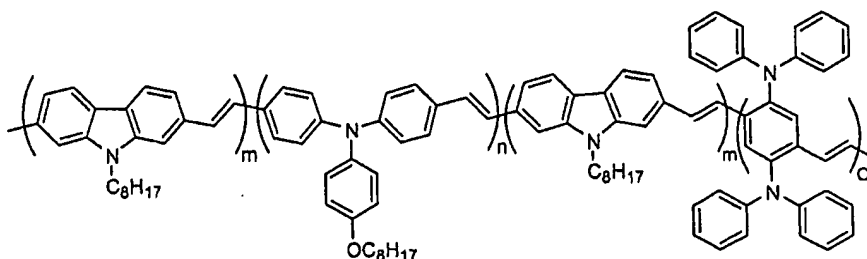
86. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

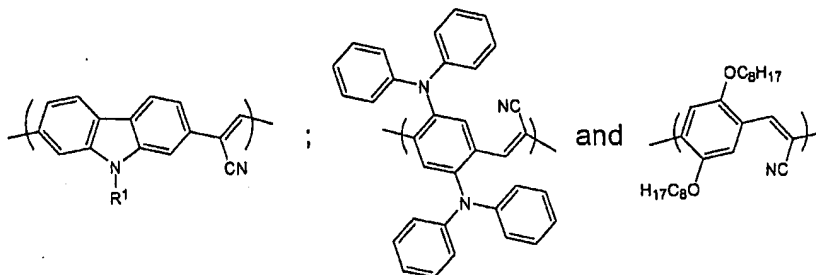
87. A polymer as defined in claim 86, wherein R¹ is hexyl or 2-ethylhexyl.

88. A polymer as defined in claim 87 having the formula:



wherein "n", "m", and "o" are integers ranging from 5 to 100.

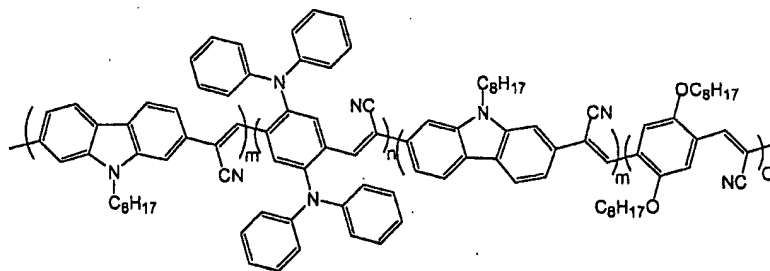
89. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R¹ is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

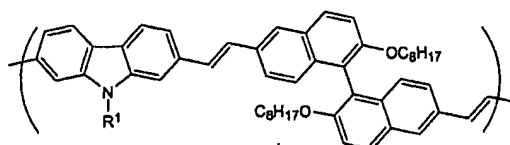
90. A polymer as defined in claim 89, wherein R¹ is hexyl or 2-ethylhexyl.

91. A polymer as defined in claim 90 having the formula:



wherein "n", "m", and "o" are integers ranging from 5 to 100.

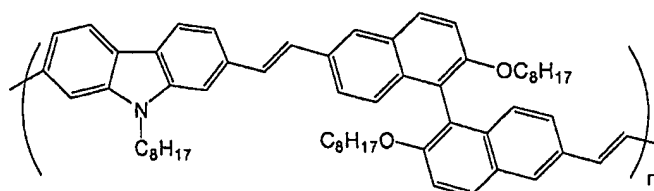
92. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

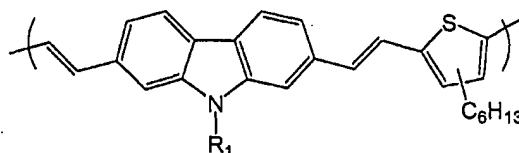
93. A polymer as defined in claim 92, wherein R^1 is hexyl or 2-ethylhexyl.

94. A polymer as defined in claim 93 having the formula:



wherein "n" is an integer ranging from 5 to 100.

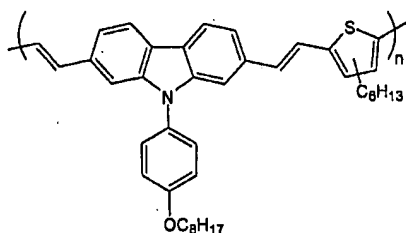
95. A polymer as defined in claim 75, comprising monomeric groups of the formula:



wherein R^1 is selected from the group consisting of methyl, ethyl, propyl, isopropyl, cyclopropyl, butyl, *sec*-butyl, *tert*-butyl, cyclobutyl, pentyl, cyclopentyl, hexyl, cyclohexyl, heptyl, cycloheptyl, octyl, cyclooctyl, 2-ethylhexyl, nonyl, decyl, phenyl and 4-octyloxyphenyl.

96. A polymer as defined in claim 95, wherein R^1 is 4-octyloxyphenyl.

97. A polymer as defined in claim 96 having the formula:



wherein "n" is an integer ranging from 5 to 100.

98. A 2,7-carbazolenevinylene-based material having charge transport properties comprising the oligomer and/or polymer of claims 40-97.

99. A film or coating having charge transport properties for use in an electronic device, comprising the oligomer and/or polymer of claims 40-97.

100. The film or coating of claim 99, wherein the electronic device is configured as a light-emitting diode.

101. The film or coating of claim 99, wherein the electronic device is configured as a field-effect transistor.

102. The film or coating of claim 99, wherein the electronic device is configured as a solar cell.